DEEP SPACE NETWORK RADIOMETRIC REMOTE SENSING PROGRAM

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Planetary spacecraft arc viewed through a troposphere that absorbs and delays radio signals propagating through it. Tropospheric water, in the form of vapor, cloud liquid, and precipitation, emits radio noise which limits satellite telemetry communication link performance. Even at X-band, rain storms have severely affected several satellite experiments including a planetary encounter. The problem will worsen with DSN implementation of Ka-band because communication link budgets will be dominated by tropospheric conditions. Troposphere-induced propagation delays currently limit VLBI accuracy and are significant sources of error for Doppler tracking. Additionally, the success of radio science programs such as satellite gravity wave experiments and atmospheric occultation experiments depends on minimizing the effect of water vapor-induced propagation delays. In order to overcome limitations imposed by the troposphere, the Deep Space Network has supported a program of radiometric remote sensing.

Currently, water vapor radiometers (WVRs) and microwave temperature profilers (MTPs) support many aspects of the Deep Space Network operations and research & development programs, Their capability to sense atmospheric water, microwave sky brightness, and atmospheric temperature is critical to development of Ka-band telemetry systems, communication link models, VLBI, satellite gravity wave experiments, and radio science missions. During 1993, WVRS provided data for propagation model development, supported planetary missions, and demonstrated advanced tracking capability.

Collection of atmospheric statistics is necessary to model and predict performance of Ka-band telemetry links, antenna arrays, and radio science experiments, Since the spectrum of weather variations has power at very long time scales, atmospheric measurements have been requested for periods ranging from one year to a decade at each DSN site. The resulting database would provide reliable statistics on daily, monthly, and seasonal variations. Only long-term monitoring will prevent biases from being introduced by an exceptionally wet or dry year,

Support for planetary missions included tropospheric calibration for the recent Mars Observer gravity wave measurements and Ka-band link experiment (KaBLE). Additionally, several proposed radio science experiments such as profiling planetary atmospheres using satellite occultations and Ka-band gravitational wave searches require advanced radiometer technology development,

Finally, there has been a consistent advanced technology program to advance satellite navigational and tracking capabilities. This year that included an experiment with radiometer-based tropospheric calibration for a series of VLBI catalog measurements.